BREAKING CASE REHABILITATION AND TECHNICAL VERIFICATION OF BREAKING SYSTEM IN THE MK 2,1×4 WINDING ENGINE MOUNTED IN LONEA MINE SKIP SHAFT

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***ABSTRACT*:** *The paper presents how the pneumatic breaking system was modernized, and how the breaking system was technically verified after the modernization of MK 2,1×4 winding engine in the Lonea Mine skip shaft. installation.*

KEY WORDS: breaking case, rehabilitation, verification

1. INTRODUCTION

According to the exploitation and occupational safety standards, each winding engine is fitted with a breaking system that provides normal movement of extraction vessels or engine stop in a certain vessel position (manoeuvre break) and automatic engine halt, irrespective of the operator's intention, in one of the following cases considered disturbances or failures: voltage interruption, break actuation working fluid pressure drop, overheating extraction vessels, exceeding admitted speed, overload etc. (safety break). Breaking device actuation for manoeuvre and safety break is done by independent apparatus. Safety beak can be intentionally caused by the operator and is accompanied by cutting off actuation motor from the mains, with the aim of a rapid and safe halt of the engine, while manoeuvre breaking is adjustable and provides a variable breaking moment, depending on them breaking signal prescribed by the operating personnel. MK 2,1x4 type winding engines(fig. 1) are in use for aproximately 35 years.

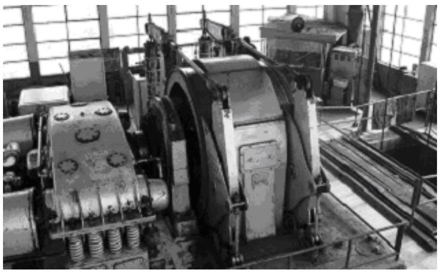

Fig. 1. MK 2,25x4 type winging engin

Electrical-pneumatic valves are still mostly original, with a fairly advanced wear. Since there are no spare parts, some functions cannot be properly executed.

This made the replacement of the present control and protection case (Fig. 2) with a new, more modern and reliable one (Fig 3) necessary.

Fig. 2. Existing control case

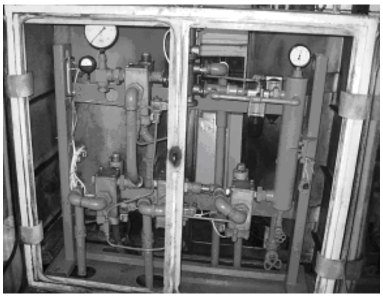

Fig. 3. Modernized control case

Fig. 4. Skip shaft winding engine

The replacement of the old breaking system (Fig. 2) with a modernized one for the winding engine was done at Lonea Mine skip shaft (Fig. 4).

2. DESCRIPTION OF THE MODERNIZED BREAKING SYSTEM

The modernized breaking system assists in converting electrical signals of the installation in pneumatic controls thereby controlling breaks. It is a case reused from a Russian decommissioned machine with newer very reliable components, made up of two basic parts.

The first part is made up of the manoeuvre break control circuit, made up of proportional electrical pneumatic regulator (Fig. 5) and three 3/2(KR) valves (Fig.6) and regulators' greaser, respectively (Fig. 7).

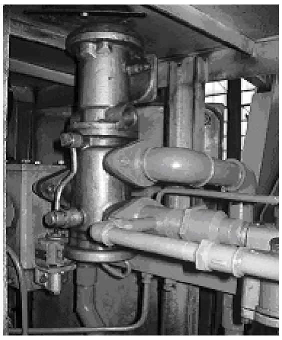

Fig. 5. Regulator

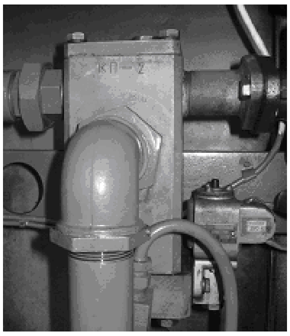

Fig. 6. Valve

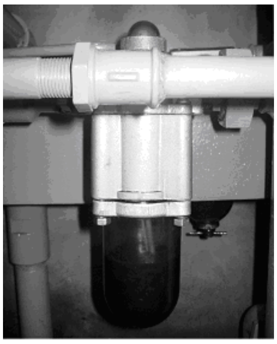

Fig. 7. Greaser

The second part is made up of two 3/2(KP) valves controlling safety breaks, and a water separator, respectively, for the valves' piloting circuit (KP, KR).

To change the case, the electrical installation had to be modified, to make possible 220Vcc controls, working voltage of the new valves, and the control logics for the new case, respectively.

3. OPERATION OF THE MODERNIZED BREKING SYSTEM

The installation works as it follows (Fig. 8):

Compressed air from the installation enters the case through a pipe. At the operator's signal, given by an analogical (0-24 V cc.) controller, compressed air is introduced in MB cylinders by a proportional electrical pneumatic regulator, at the pressure desired by the operator, breaking being done by manoeuvre beaks. In safety breaking regime, when one of the SB circuit conditions is triggered, the air from the SB cylinders is removed through the four 3/2 valves, breaking being done at a seed that would achieve the desired deceleration in the breaking system.

The breaking case shown is made up of two basic components

a. Manoeuvre break system.

The systems actuates the machine at the command of the winding engine operator, through a controller, generating a 20-120mA analogical signal for the electrical pneumatic regulator. In its turn, it controls the proportional electrical pneumatic regulator, which makes air exit in the manoeuvre break cylinders at the pressure prescribed by the extraction operator through the controller, creating a tightening force of the breaking system shoes directly proportional to the pressure in the cylinders.

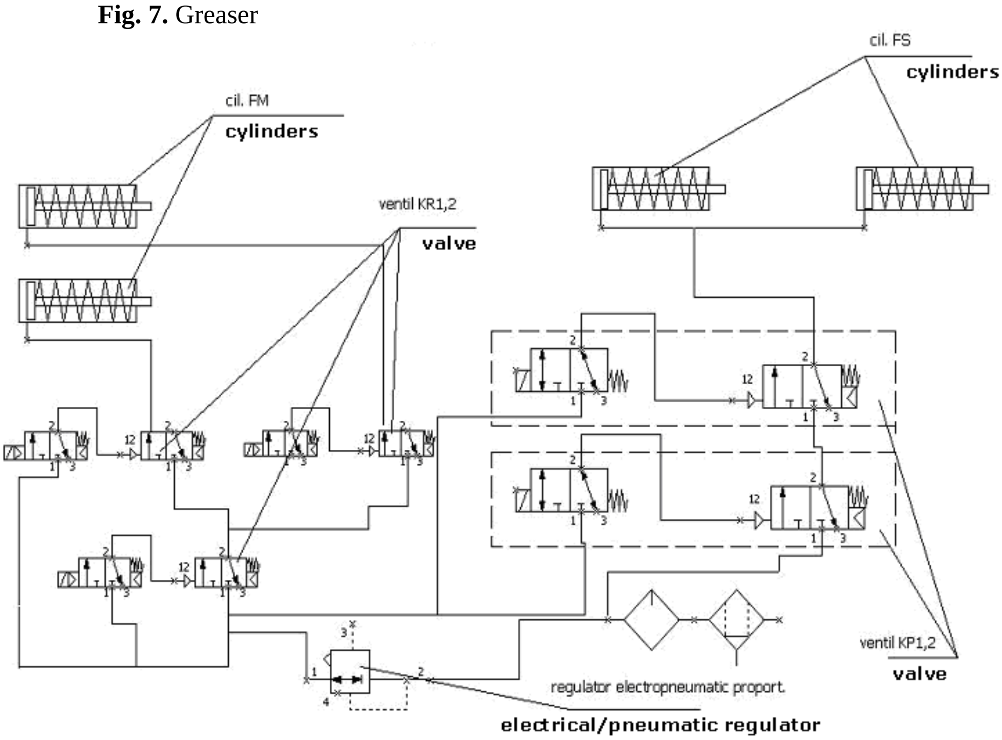

Fig. 8. Basic pneumatic diagram for modernized control case for MK 2,1×4 winding engine

b. Safety break system.

The system actuates the machine when one of the conditions in the protection circuit of the safety break disappears, r when SB trigger is actuated, removing air from SB cylinders through the electrical pneumatic valves, thus the system's counterweights exert a contraction force proportional to their weight on the shoes.

In the same time, when safety break fails when the manoeuvre break is open (p = max.), the system releases the manoeuvre break cylinders pressure, providing a double breaking safety.

The actual breaking of the machine is done by MB, since the reaction time is better, that is the physical time required to execute the breaking movement is less.

4. LOCATION AND INSTALLATION OF THE SYSTEM

Location of the pneumatic control case is in place of the decommissioned case.

The installation between the pneumatic case and the cylinders is done by 20 bar pneumatic hoses.

The case was mounted by Paroseni Mine assisted by Technosam Satu Mare.

When in case of dismounting, the compressed air pipe from the main supply network will be found clogged, it will be replaced.

5. TECHNICAL VERIFIATION OF MODERNIZED BREAKING SYSTEM

MK 2,1 x 4 type winding engine is intended to transport materials between two levels (loading and dumping station).

The forces required for moving the skips are transmitted by friction force between the four extraction cables and the lining on the friction wheel (driving wheel).

To reduce the unbalances load, two compensation cables are used.

The machine is driven by two asynchronous motors with wound rotor fed at 6 kV.

Start and adjustment of speed is done by increasing or decreasing the resistance in the rotor circuit, and in positioning manoeuvres or low speed movements (shaft revision) mechanical break is applied.

The machine is equipped with two breaks, with springs and counterweights, with parallel shoe movement.

Breaks are controlled through a new, reused pneumatic case.

Protection devices that apply safety break in case of emergency or abnormal operation of the machine are of classic design(relays, limiters, sensors etc.)

MK 2,1 x 4 type winding engine was submitted to technical verification, for adjusting and verification work, considering that existing breaking board was replaced by a new adapted breaking board

In view of technical verifications, decelerations in safety break application in case of empty and full skip movement were determined, which in all cases should be in the range imposed by non-slip conditions for the cables, safety coefficient of breaking moments, determined by calculations, and experimentally, by resistive electrical tensiometry method, delay times in the application of the safety break.

The values of the stretching forces in bars experimentally determined in view of calculating the safety coefficients of breaking moments, of decelerations, of delay times in safety break application, determined based on speed records are given in the following diagrams (Figs. 9, 10, 11, and 12).

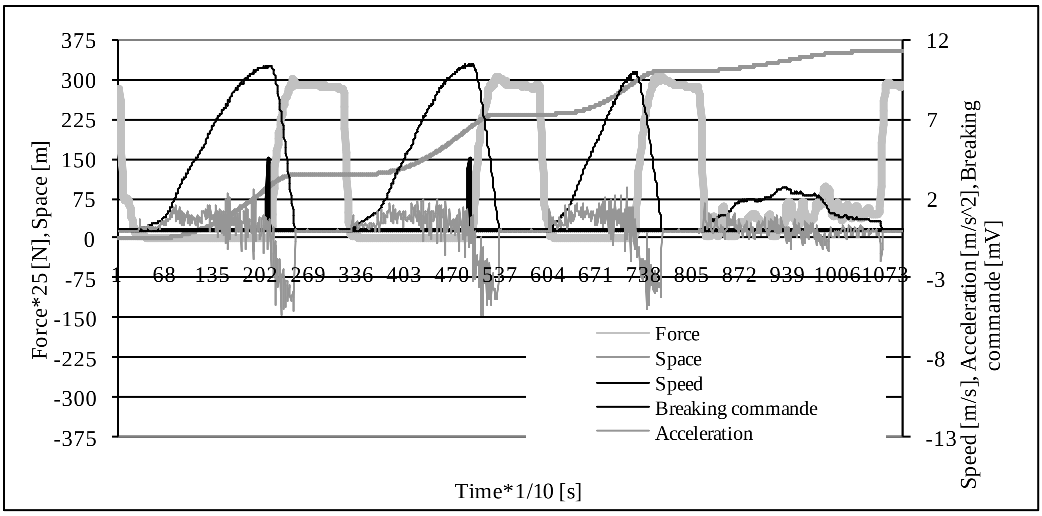

Fig. 9. Empty skip right above complete run

6. CONCLUSIONS

The pneumatic components used in the system are SMC Japanese made. He electrical part are Schneider Electric.

The solutions adopted solve the safety and operation problems required by a breaking system with air, the principle being "air catches breaks" in a winding engine with driving wheel. At final adjustment, decelerations with empty skips were in the range of $3{,}31 m/s^2$-$3{,}52 m/s^2$, with full skips$3{,}64 m/s^2$-$3{,}95 m/s^2$, less than critical values determined from the condition of

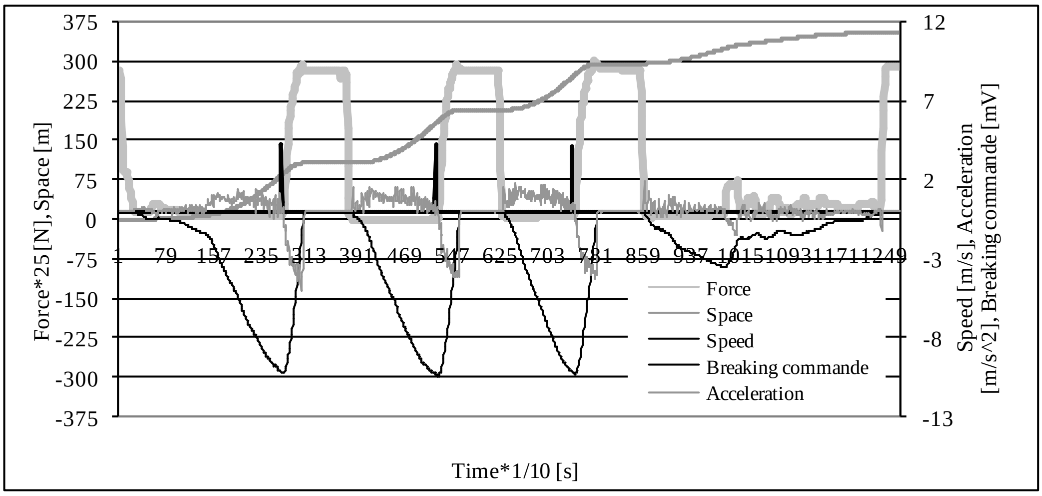

Fig. 10. Empty skip left above complete run

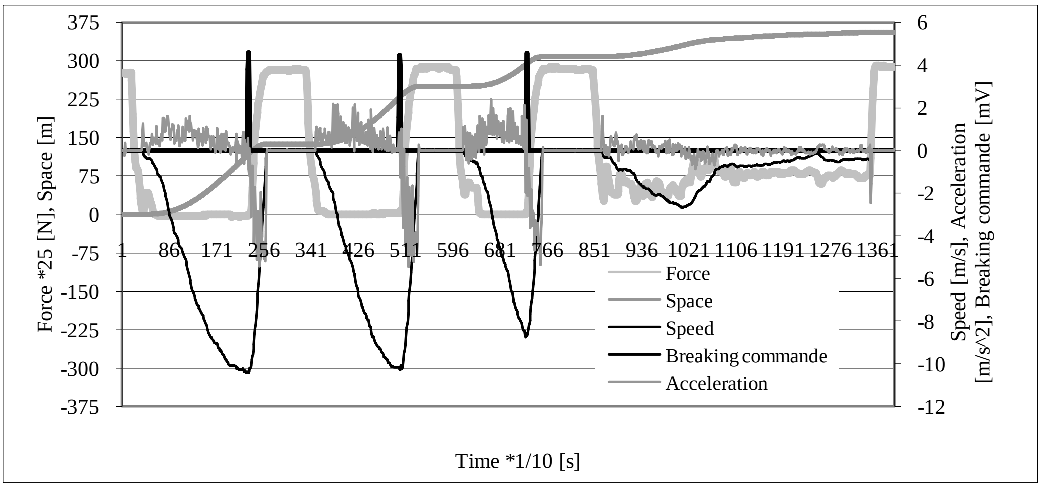

Fig. 11. Full skip left above complete run

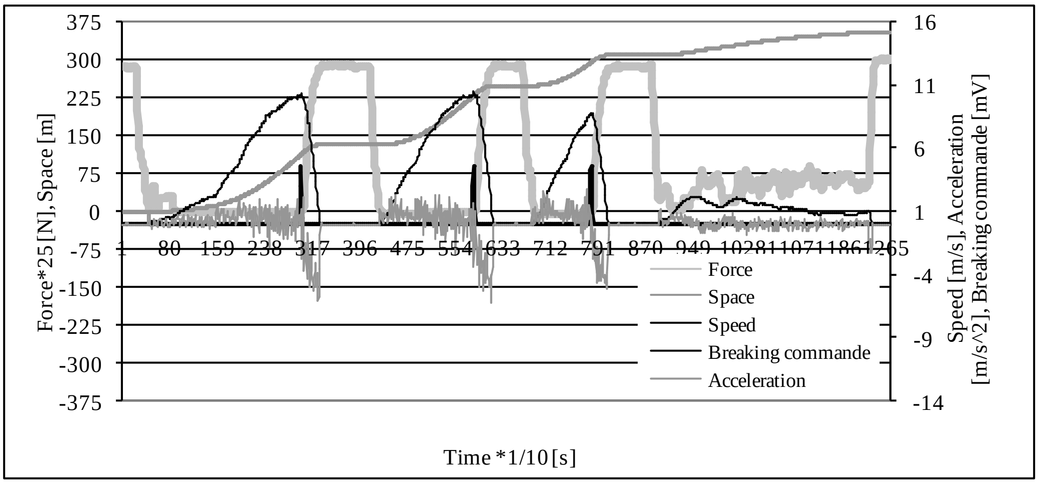

Fig. 12. Full skip right above complete run

non-slipping cables. Delay times in safety break application were in the range of 0,4s-0,6s. Safety coefficients of calculated breaking moments are k_s=2,93 for safety breaks, k_m=2,93 for manoeuvre breaks and those experimentally calculated are k_s=2,679 for safety break k_m=2,358 for manoeuvre break, respectively.

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